2016 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Seeding Rate Response of Modern Fall Rye Varieties

(Project #20150323)

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Project Identification

1. **Project Title:** Seeding Rate Response of Modern Fall Rye Varieties
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3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
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5. **Project start and end dates (month & year):** Sep-2015 to Dec-2016
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The objective of this field trial was to demonstrate the optimal fall rye seeding rates for high yielding hybrids versus conventional open pollinated varieties.

8. **Project Rationale:**

While fall rye acres have dramatically declined since peaking in the 1980s (due to herbicides, other profitable crop options, and limited markets), commercial availability of new hybrid varieties has renewed interest in this crop. Averaged across the major provincial zones, the three currently available European hybrids (Brasetto, Guttino and Bono) reportedly yield 120-126% of the current check (and highest yielding open pollinated variety) Hazlet (SaskSeed 2016 Guide). Traditionally, fall rye has been grown as a low-input crop, likely because it has relatively high nitrogen (N) use efficiency compared to winter wheat and tends to be grown on poorer land. A separate project (ADOPT #20150322) is evaluating hybrid versus open pollinated (OP) fall rye response to N fertilizer applications; however, when transitioning to hybrids, seed costs for this crop will increase dramatically. This increase is due to the combination of higher initial costs and the requirement to purchase new seed on annual basis. Farmers will benefit from third party validation of optimal seeding rates in order to help them make informed decisions and the necessary investments with confidence. The objective of this demonstration was to demonstrate the overall yield potential and relative responses to a wide range of seeding rates for both open pollinated and hybrid fall rye.

Methodology and Results

9. **Methodology:**

A field trial was initiated in the fall of 2015 near Indian Head, Saskatchewan (50.556 N, 103.603 W). A similar trial was conducted near Melfort which is also summarized in this report. Indian Head is located in the thin-Black soil zone of southeast Saskatchewan and the soil is classified as an Indian Head heavy clay with typical organic matter concentrations of 4-5%. The treatments were a factorial combination of two varieties and six seeding rates. The variety was either Hazlet (OP) or Brasetto (hybrid) and the N

rates were 50, 110, 170, 230, 290 or 350 seeds m^{-2} (12 treatments in total). The treatments were arranged in a Randomized Complete Block Design (RBCD) with four replicates.

All available and pertinent agronomic information is provided in Table 1. Treated fall rye seed was direct seeded into canola stubble on September 20 (2015) and September 22 (2015) at Indian Head and Melfort, respectively. Seed rates varied as per protocol and the fertilizer sources were urea (side-banded), monoammonium phosphate (side-banded), and potassium sulphate (seed-placed) at Indian Head. Fertilizer rates were held constant across treatments. Weeds were controlled using registered pre-emergent and in-crop herbicide applications. Foliar fungicide was applied during early heading to protect against late occurring leaf disease and, potentially, fusarium head blight. At Indian Head, pre-harvest glyphosate was applied at maturity on July 28 and the centre five rows of each plot were straight-combined on August 12-13 (2016). At Melfort, the plots were desiccated with Reglone on August 2 and combined on August 16 (2016).

Table 1. Agronomic information for the ADOPT Fall Rye Seeding Rate Response Demonstration at Indian Head and Melfort (2015-16).

Factor / Field Operation	Indian Head 2016-15	Melfort 2016-15
Previous Crop	Canola (LL)	Canola
Pre-emergent herbicide	880 g glyphosate ha^{-1} + 729 g 2,4-D ha^{-1} (Sep-24-2015)	none
Seed Treatment	Cruiser Vibrance Quattro	Cruiser Vibrance Quattro
Seeding Date	Sep-20-2015	Sep-23-2015
Row spacing	30 cm	23 cm
kg N-P_2O_5-K_2O-S ha^{-1}	115-30-47-16	124-25-0-19
Fall Plant Density	Oct-15-2016	n/a
Spring Plant Density	Apr-28-2016	May-27-2016
In-crop herbicide	280 g bromoxynil ha^{-1} + 280 g MCPA ester ha^{-1} + 198 g tralkoxydim ha^{-1} (May-17-2015)	140 g fluroxypry ha^{-1} + 99 g clopyralid ha^{-1} + 554 g MCPA ha^{-1} (May-16-2016)
Foliar fungicide	89 g metconazole ha^{-1} (June 5)	89 g metconazole ha^{-1} (June 18)
Head Density	Jun-15-2016	n/a
Pre-harvest herbicide	880 g glyphosate ha^{-1} (Jul-28-2016)	415 g diquat ha^{-1} (Aug-2-2016)
Harvest date	Aug-12-2016	Aug-16-2016

n/a – information not available

Various data were collected during the growing season and from the harvested grain samples. Emergence was determined both in the fall and again in the spring by counting the number of plants in two separate marked 1 m sections of crop row and converting the values to plants m^{-2}. Head density was determined by counting the number of heads in the marked rows and converting the values to heads m^{-2}.

The average number of heads per plant was calculated by dividing the observed heads m^{-2} by the observed spring plants m^{-2}. Lodging was assessed at maturity using the Belgian lodging scale where the area of the plot affected was rated (A=1-9) along with the intensity of lodging in affected areas (I=1-5). The lodging index (LI) for each plot is subsequently calculated using the formula LI = A × I × 0.2. Yields were determined from the harvested grain samples and are expressed as kg ha^{-1} clean seed (corrected to a constant seed moisture content of 14%). Dockage was determined from a 1000 g sub-sample using CGC methodology and grain moisture was determined from a Labtronics Model 919 moisture meter for the purpose of correcting grain yields. All ergot bodies were handpicked from a 500 g clean subsample and subsequently weighed to determine percent ergot. Daily temperature and precipitation data were estimated from a privately owned weather station located approximately 2.5 km southeast of the Indian Head site and from the nearest Environment Canada weather station at Melfort.

All response data were analysed using the Mixed procedure of SAS with the effects of variety (VAR), seeding rate (SR) and their interaction (VAR × SR) considered fixed and replicate effects considered random. Treatment means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the observed N responses were linear or quadratic (curvilinear) in shape. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

10. Results:

Growing season weather

Weather data for the 2016 growing seasons at Indian Head and Melfort are presented in Table 2. Winters at both site were milder than normal and, at Indian Head, snow cover was negligible over the entire winter. At both locations in 2016, temperatures were above normal for May, June and July and slightly below normal in August. Growing season precipitation was above normal with the most precipitation received in July at both locations. At Indian Head, May and June tended to wetter than normal while August was relatively dry. At Melfort, conditions were drier earlier in the season but wetter than normal in July and August.

Table 2. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2015 growing season at Indian Head, SK.

Year	April	May	June	July	August	Avg. / Total
	---------- Mean Temperature (°C) ----------					
IH-2016	3.8	13.9	17.5	18.5	17.1	14.2
IH-LT	4.2	10.8	15.8	18.2	17.4	13.3
ME-2016	2.9	13.6	17.1	18.1	16.3	13.6
ME-LT	2.8	10.7	15.9	17.5	16.8	12.7
	---------- Precipitation (mm) ----------					
IH-2016	13.9	72.6	63.0	112.8	29.8	292
IH-LT	17.1	51.8	77.4	63.8	51.2	261
ME-2016	13.5	16.8	53.2	128.7	80.8	293

ME-LT	26.7	42.9	54.3	76.7	52.4	253

Detailed Field Trial Results

Results of the overall tests of fixed effects are presented for all response variables in Table 3. In this test, p-values that are less than or equal to 0.05 indicate that we are at least 95% confident that an observed effect was due to the treatment and not naturally occurring or random variability. At Indian Head, both VAR and SR affected all response variables ($P < 0.001$) and the VAR × SR interaction was also significant in all cases ($P < 0.001$-0.044). At Melfort, variety affected fall and spring plant populations ($P = 0.003$-0.035), tillers ($P = 0.049$) and yield ($P < 0.001$) but not head density ($P = 0.44$) or lodging ($P = 0.22$). Seed rate affected all variables ($P < 0.001$-0.003) except lodging ($P = 0.47$). Except for spring plant density ($P = 0.050$), the VAR × SR interaction was not significant in any cases at Melfort (P =0.47-0.48).

Table 3. Overall effects of variety (VAR) and seeding rate (SR) effects on selected response variables for fall rye at Indian Head and Melfort in 2016. P-values less than or equal to 0.05 indicate that treatment effects or interactions were significant.

Site-Year	Effect	Fall Plants	Spring Plants	Heads	Tillers	Lodging	Yield	Ergot
		p-values						
Indian Head (2016)	VAR	< 0.001	< 0.001	0.010	< 0.001	< 0.001	< 0.001	< 0.001
	SR	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	VAR x SR	0.001	0.012	0.035	< 0.001	0.044	< 0.001	< 0.001
Melfort (2016)	VAR	0.035	0.003	0.443	0.049	0.218	< 0.001	–
	SR	< 0.001	< 0.001	< 0.001	0.004	0.467	0.003	–
	VAR x SR	0.525	0.050	0.885	0.526	0.467	0.882	–

Because the observed densities were similar and there were no consistent trends to suggest either winter kill or delayed emergence (after fall counts had been completed), only the spring densities are presented (Table 4). At Indian Head 2016, fall and spring plant populations were similar for any individual treatments indicating little or no winter kill. Overall, plant densities were higher for the OP variety (178 plants m^{-2}) than for the hybrid (145 plants m^{-2}) and, averaged across varieties, each incremental seeding rate increase resulted in a significant increase in plants m^{-2}. Spring plant populations at Indian Head ranged from 52 plants m^{-2} at the 50 seeds m^{-2} rate to 252 plants m^{-2} at the 350 seeds m^{-2}. It is not uncommon for seedling mortality to increase with seeding rates due to increased intraspecific competition, particularly at excessive rates. The VAR × SR interaction was significant at Indian Head and appeared to be due to a subtlety wider spread between the OP and hybrid varieties at the highest seeding rates.

At Melfort, overall average plant populations for the OP variety (119 plants m^{-2}) were also higher than for the hybrid (95 plants m^{-2}) and there was a linear increase in plant populations with seeding rate;

however, variability was higher and the range was smaller (57-149 seeds m^{-2}) compared to Indian Head. The lack of a VAR × SR interaction suggested that the plant population response to seeding rate was similar for each variety across the entire range of rates evaluated at this site-year.

In general, at the higher seeding rates, mortality was higher at Melfort than at Indian Head and plant populations did not increase significantly beyond seeding rates of approximately 230 seeds m^{-2} at this location. The differences in plant populations between fall (Table A-1) and spring (Table 4) were also higher at Melfort than Indian Head but were not consistent; therefore these differences were attributed to within plot variability as opposed to either winter kill or delayed emergence.

Table 4. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on fall rye plant densities (spring) at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- spring plants/m^2 ----------					
All Seed Rates	—	—	175 a	118 a	143 b	95 b
S.E.M.	—	—	3.9	5.0	3.9	5.0
50 seeds/m^2	52 f	41 e	68 i	41 d	36 j	42 d
110 seeds/m^2	106 e	77 d	111 gh	88 bc	102 h	66 cd
170 seeds/m^2	140 d	93 cd	148 ef	98 bc	132 fg	87 bc
230 seeds/m^2	175 c	117 bc	184 cd	122 b	165 de	112 b
290 seeds/m^2	230 b	133 b	266 a	172 a	195 c	95 bc
350 seeds/m^2	252 a	176 a	273 a	185 a	232 b	166 a
S.E.M	6.3	8.7	8.7	12.3	8.7	12.3
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
NR – quad	0.194	0.661	0.982	0.933	0.073	0.482

Mean head densities (heads m^{-2}) are presented for Indian Head and Melfort (2016) in Table 5. Despite the higher plant populations with the OP variety, head densities were generally similar or even higher for the hybrid. This suggests the hybrid had a greater capacity to produce tillers and potentially compensate for lower plant populations than the OP variety. Averaged across seeding rates at Indian Head, 471 heads m^{-2} were recorded with the OP variety while the hybrid averaged 497 heads m^{-2}. The response to seeding rate for both varieties was distinctly quadratic with fewer tillers as seeding rate increased. The VAR × SR interaction was significant and appeared to be due to heads m^{-2} levelling off at slightly lower seeding rates with the hybrid relative to the OP variety. For Hazlet, heads m^{-2} peaked at 290 seeds m^{-2} while, for Brasetto, there were no further increases in head density beyond the 230 seeds

m^{-2} seeding rate. This observation was supported by the orthogonal contrasts which showed a linear increase in head density with increasing seeding rates for the OP variety but a quadratic increase with the hybrids.

While variability was somewhat higher and head densities were lower at Melfort, the overall results were similar to those at Indian Head. Again, head densities in the OP variety increased with seeding rate in a linear manner while heads m^{-2} for the hybrid leveled off at the relatively low seeding rate of 170 seeds m^{-2}. Head densities did not differ between varieties (396-410 heads m^{-2}) at Melfort when averaged across seeding rates.

Table 5. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on fall rye head density at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- heads/m^2 ----------					
All Seed Rates	–	–	471 b	396 a	497 a	410 a
S.E.M.	–	–	7.7	17.8	7.7	17.8
50 seeds/m^2	386 d	253 c	410 e	263 cd	361 f	243 d
110 seeds/m^2	458 c	353 b	440 de	352 bc	477 cd	354 bc
170 seeds/m^2	466 c	453 a	451 de	431 ab	481 bcd	475 a
230 seeds/m^2	509 b	432 a	476 cd	412 ab	542 a	452 a
290 seeds/m^2	546 a	460 a	527 ab	447 a	566 a	474 a
350 seeds/m^2	540 ab	467 a	523 abc	470 a	557 a	464 a
S.E.M	12.3	25.6	17.0	34.1	17.0	34.1
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
NR – quad	0.016	< 0.001	0.955	0.093	0.001	0.002

The average number of heads per plant was calculated from the plant and head densities as a means of measuring treatment effects on tillering. At Indian Head, there were 3.3 heads $plant^{-1}$ in the OP variety and 4.5 heads $plant^{-1}$ in the hybrid when averaged across seeding rates (Table 6). Across varieties, tillering declined with increasing seeding rates in a curvilinear manner, levelling off at 2.2-2.4 heads plant at the 290 seeds m^{-2} rate. The significant interaction appeared to be mostly due to the hybrid producing more tillers than the OP variety at lower seeding rates (50-110 seeds m^{-2}). For example, at the 50 seed m^{-2} seeding rate there were 10.1 versus 6.1 heads $plant^{-1}$ for the hybrid and OP varieties, respectively. For rates from 170-350 seeds m^{-2} the two varieties produced a similar number of tillers.

Similar to Indian Head, tillering was also higher with the hybrid on average (5.1 versus 4.0 heads plant^{-1}) at Melfort. There was an overall linear decline in tillering with increasing seeding rates whereby (averaged across varieties) the number of heads plant^{-1} fell from 6.5 at 50 seeds m^{-2} to 2.7 at 350 seeds m^{-2} when averaged across varieties.

Table 6. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on tillering in fall rye at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- heads/plant ----------					
All Seed Rates	—	—	3.3 b	4.0 b	4.5 a	5.1 a
S.E.M.	—	—	0.19	0.36	0.19	0.36
50 seeds/m^2	8.2 a	6.5 a	6.2 b	6.4 ab	10.1 a	6.6 a
110 seeds/m^2	4.5 b	4.8 ab	4.0 d	4.3 a-d	4.9 c	5.4 abc
170 seeds/m^2	3.3 c	5.2 ab	3.0 efg	4.7 a-d	3.7 de	5.7 abc
230 seeds/m^2	3.0 cd	3.8 bc	2.6 fgh	3.6 cd	3.3 def	4.1 bcd
290 seeds/m^2	2.4 de	4.3 bc	2.0 h	2.7 d	2.9 efg	5.9 abc
350 seeds/m^2	2.2 e	2.7 c	2.0 h	2.6 d	2.4 gh	2.8 d
S.E.M	0.26	0.62	0.33	0.88	0.33	0.88
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.014
NR – quad	< 0.001	0.870	< 0.001	0.522	< 0.001	0.682

Lodging ratings were completed just prior to maturity. While lodging does not always affect yield, particularly when it occurs close to maturity, heavily lodged crops are more difficult to harvest. At Indian Head, lodging was significantly less with the hybrid and was affected by seeding rate in a quadratic manner whereby it was most severe at the lowest and highest rates but negligible at more intermediate rates (Table 7). The VAR × SR was significant and due to the increase in lodging at extremely high seeding rates being more pronounced with the OP variety. While subtle treatment effects were observed, lodging was negligible in all cases for the hybrid at Indian Head in 2016.

At Melfort, lodging was very minor and was not affected by variety, seeding rate or the interaction between these two factors.

Table 7. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on lodging in fall rye at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- 1-10 ----------					
All Seed Rates	–	–	1.66 a	0.32 a	0.43 b	0.20 a
S.E.M.	–	–	0.099	0.07	0.099	0.07
50 seeds/m^2	1.53	0.20 a	2.25 a	0.20 b	0.80 bc	0.20 b
110 seeds/m^2	0.79	0.20 a	1.25 b	0.20 b	0.33 cd	0.20 b
170 seeds/m^2	0.73	0.28 a	1.15 b	0.35 ab	0.30 d	0.20 b
230 seeds/m^2	0.74	0.20 a	1.20 b	0.20 b	0.28 d	0.20 b
290 seeds/m^2	1.11	0.48 a	1.88 a	0.75 a	0.35 cd	0.20 b
350 seeds/m^2	1.38	0.20 a	2.25 a	0.20 b	0.50 cd	0.20 b
S.E.M	0.139	0.12	0.183	0.165	0.183	0.165
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	0.813	0.436	0.182	0.273	0.311	1.000
NR – quad	< 0.001	0.588	< 0.001	0.441	0.029	1.000

Fall rye grain yields at Indian Head averaged 5332 kg ha^{-1} (85 bu ac^{-1}) for the OP variety and 6695 kg ha^{-1} (106 bu ac^{-1}) for the hybrid, a yield advantage of 26% (Table 8). Averaged across varieties, yields were lowest at the 50 seeds m^{-2} rate and peaked at approximately 170 seeds m^{-2} with a slight decline at the highest seeding rate. The response was reasonably consistent for both varieties whereby yields peaked at similar seeding rates; however, the VAR × NR interaction was significant due to the reduced yield at the highest rates occurring in the hybrid but not the OP variety.

At Melfort, yields were highly variable; however, the hybrid rye (5077 kg ha^{-1}) yielded 18% higher than the OP variety (4302 kg ha^{-1}). Yields were lowest at the 50 seeds m^{-2} rate and, according to multiple comparisons, did not significantly differ for rates ranging from 110-350 seeds m^{-2}. That said, the orthogonal contrasts indicated an overall linear yield increase with increasing seeding rates both when averaged across varieties and for individual varieties.

Table 8. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on yield in fall rye at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- kg/ha ----------					
All Seed Rates	–	–	5332 b	4302 b	6695 a	5077 a
S.E.M.	–	–	57.7	520.3	57.7	519.5
50 seeds/m^2	5625 c	3814 b	5161 e	3526 e	6089 c	4103 de
110 seeds/m^2	6153 a	4862 a	5374 d	4258 cde	6933 a	5466 a
170 seeds/m^2	6205 a	4788 a	5438 d	4503 bcd	6972 a	5072 abc
230 seeds/m^2	6085 a	4832 a	5345 de	4443 bcd	6824 a	5222 ab
290 seeds/m^2	6076 ab	5040 a	5340 de	4710 a-d	6812 a	5370 a
350 seeds/m^2	5938 b	4801 a	5334 de	4371 cd	6542 b	5231 ab
S.E.M	70.5	546.9	86.1	582.8	86.1	582.8
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	0.006	0.003	0.261	0.030	0.005	0.030
NR – quad	< 0.001	0.009	0.041	0.064	< 0.001	0.053

Ergot was only measured at Indian Head and is an important grading factor with levels of 0.05-0.2% resulting in a CW No. 2 grade and a demotion to sample if ergot levels exceed 0.33%. Averaged across all seeding rates, ergot levels were relatively high averaging 0.33% in the OP variety and 0.65% for the hybrid (Table 9). There was a clear seeding rate effect whereby the ergot was highest at suboptimal seeding rates and slightly higher seeding rates were required to minimize ergot than to maximize grain yield when averaged across varieties. The VAR × SR interaction was significant in that the increase in ergot at lower plant populations was more prominent in the hybrid than the OP variety. For seeding rates of 170-350 seeds m^{-2} percent ergot did not significantly differ between the two varieties; however, the trend was always for higher ergot in the hybrid.

Table 9. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on percent ergot in fall rye at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- % ergot ----------					
All Seed Rates	–	–	0.33 b	–	0.65 a	–
S.E.M.	–	–	0.052	–	0.052	–
50 seeds/m^2	1.26 a	–	0.80 b	–	1.72 a	–
110 seeds/m^2	0.52 b	–	0.28 c	–	0.76 b	–
170 seeds/m^2	0.30 c	–	0.26 c	–	0.34 c	–
230 seeds/m^2	0.28 c	–	0.21 c	–	0.35 c	–
290 seeds/m^2	0.33 c	–	0.24 c	–	0.42 c	–
350 seeds/m^2	0.28 c	–	0.23 c	–	0.33 c	–
S.E.M	0.074	–	0.098	–	0.098	–
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	< 0.001	–	< 0.001	–	< 0.001	–
NR – quad	< 0.001	–	0.002	–	< 0.001	–

Extension Activities and Dissemination of Results

This demonstration was highlighted during the IHARF Crop Management Field Day (July 19, 219 registered guests) where Chris Holzapfel (IHARF) and Dr. Brian Beres (AAFC-Lethbridge) led a discussion on winter cereal agronomy and opportunities. The trial was also shown and discussed by Chris Holzapfel on a tour co-hosted with Arysta Lifesciences (July 26, 45 guests). In addition to these more formal tours, the site was visited by numerous growers, agronomists and researchers over the season. Final data from these presentations will be presented at the Agri-ARM Research Update on January 12, 2017 as part of Crop Production Week. Results from the project will also be made available in the 2016 IHARF Annual Report (available online) and through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, etc.) as opportunities arise. This demonstration is being continued at Indian Head in 2016-17 and data from all suitable locations will be combined in a cumulative report upon conclusion of the project.

11. Conclusions and Recommendations

This project has demonstrated the relative yield potential and seeding rate response of modern open pollinated (Hazlet) versus hybrid (Brasetto) fall rye varieties at Indian Head and Melfort, Saskatchewan. With good fall moisture conditions and a mild winter/spring, overall establishment was excellent at Indian Head and this should be taken into consideration when interpreting results. At Melfort, establishment and overwinter survival was also adequate; however, overall mortality was higher particularly at the most aggressive seeding rates. While both varieties compensated well for lower plant

populations through increased tillering, the hybrid produced more heads plant^{-1} at lower seeding rates and averaged across seeding rates. This was evident in the measurements of head density where heads m^{-2} increased linearly for the OP rye and quadratically with the hybrid. Minor lodging and significant treatment effects were detected at Indian Head where lodging was worse overall with the OP variety and most severe at the lowest and highest seeding rates. Lodging was always negligible at more optimal seeding rates and with the hybrid, regardless of seeding rate. Seed yields at Melfort were highly variable but showed an 18% yield advantage to hybrids and an overall tendency for higher yields as seeding rates were increased (5625 kg ha^{-1} at 50 seeds m^{-2} to up to 6205 kg ha^{-1} at 170 seeds m^{-2}). At Indian Head, the hybrid out yielded the OP variety by 26% when averaged across seeding rates with both a significant seeding rate effect and variety by seeding rate interaction. For both varieties maximum yields were achieved at relatively low seeding rates (~170 seeds m^{-2}); however the interaction was due to yields declining the when seeding rate was increased to the maximum level in the hybrid but not the OP variety. From an economic perspective, grain yield is important but quality is also a major factor that growers must consider. One of the greatest causes of down grading in fall rye is ergot and this parameter was measured at Indian Head. Ergot was higher overall in the hybrid but was also affected by seeding rate, declining as seeding rate was increased and generally minimized at seeding rates of 170 seeds m^{-2} or higher. While percent ergot did not differ between varieties or seeding rates at the 170-350 seeds m^{-2} levels, it was high enough to be of some concern for all treatments and became a major grading factor when plant populations fell below ~110-130 plants m^{-2}. Based on the results from this demonstration, both hybrid and OP fall rye varieties appeared to respond similarly to seeding rates. While the hybrid yielded 18-26% higher than the OP variety, the higher yield potential must be weighed against increased seed costs. Overall, it appears that target seeding rates of approximately 200 seeds m^{-2} are sufficient to optimize both yield and quality; however, this recommendation is currently based on limited data. This project is continuing at Indian Head 2016-17.

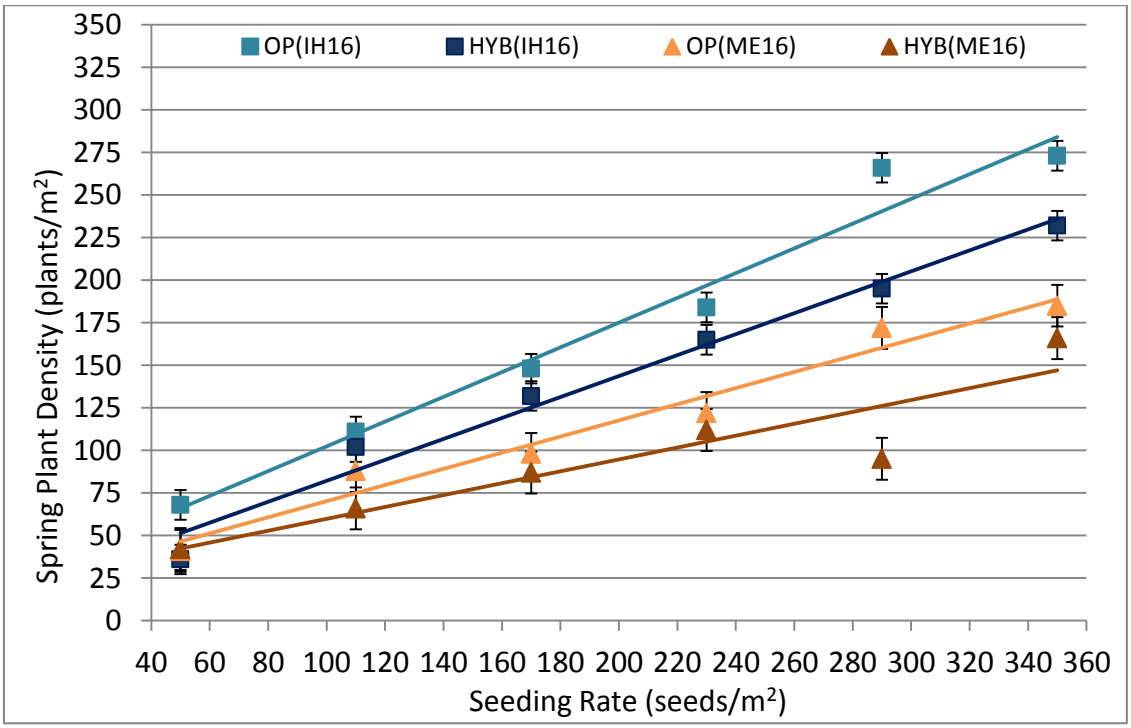

Figure 1. Seeding rate effects on fall rye (hybrid versus open pollinated) spring plant densities at Indian Head and Melfort (2015-16).

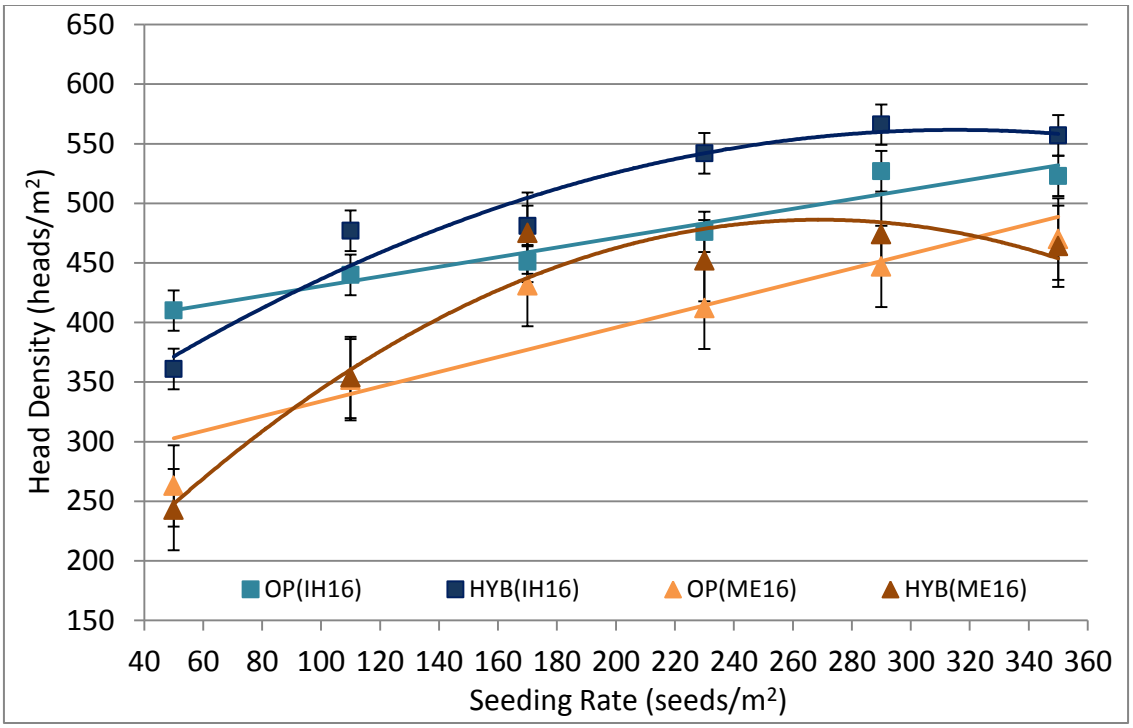

Figure 2. Seeding rate effects on fall rye (hybrid versus open pollinated) head densities at Indian Head (2015-16) and Melfort (2016).

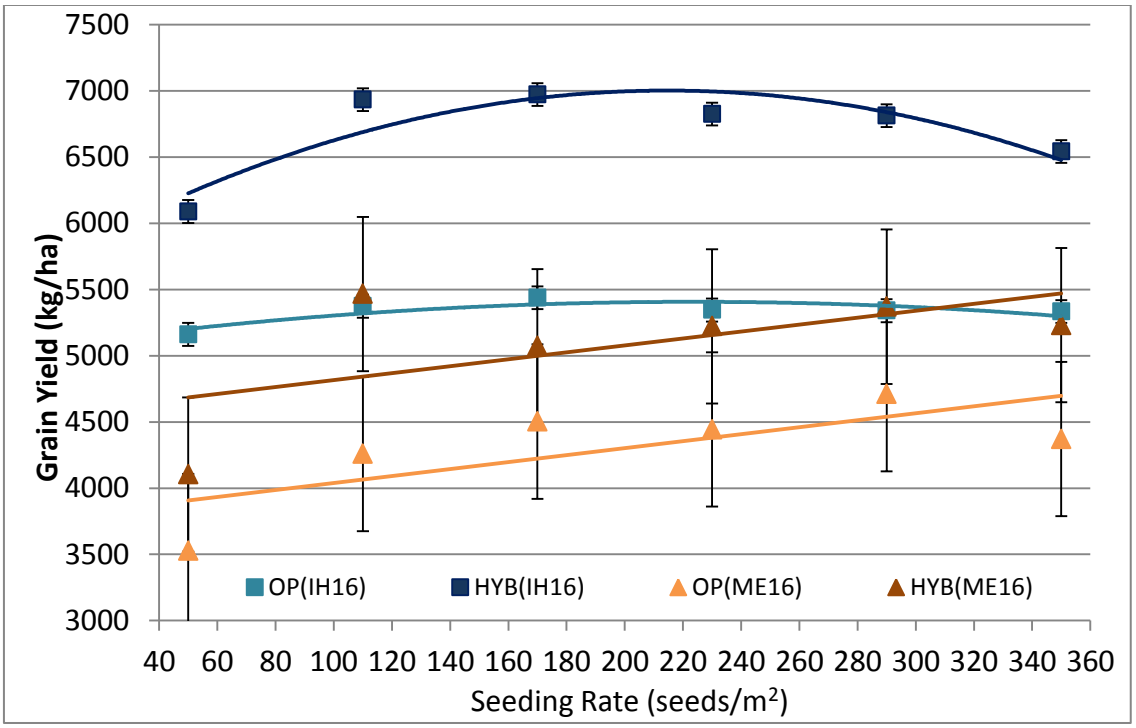

Figure 3. Fall rye (hybrid versus open pollinated) lodging at varying seeding rates at Indian Head (2015-16) and Melfort (2016).

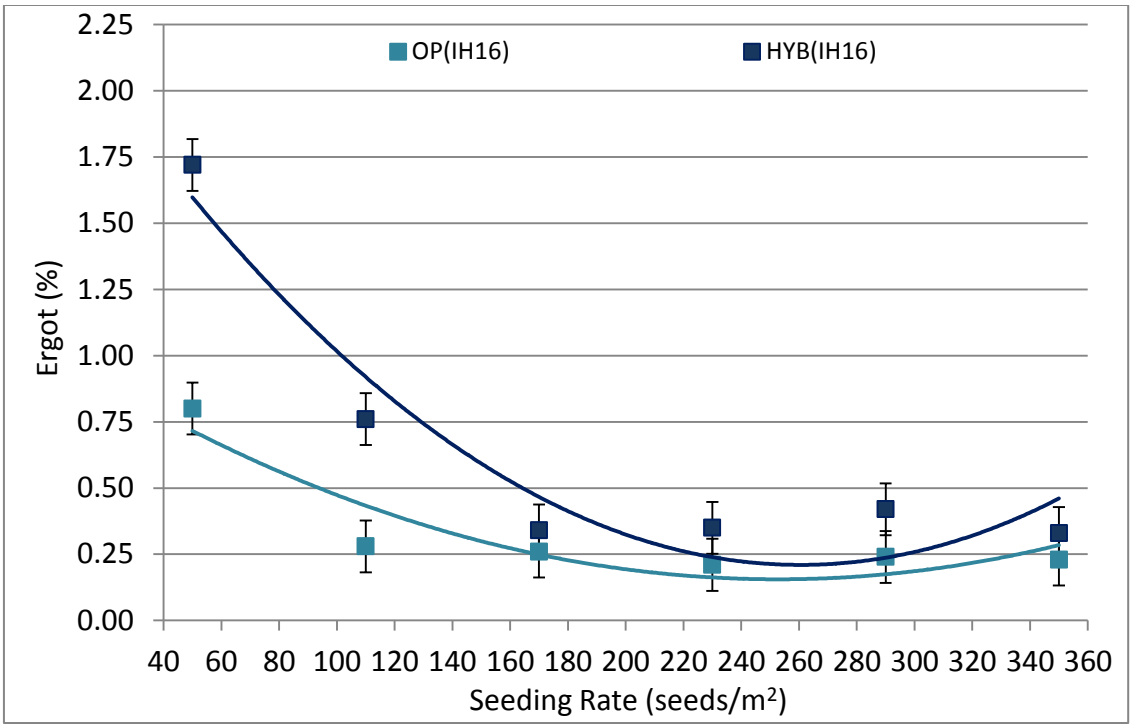

Figure 4. Fall rye (hybrid versus open pollinated) lodging at varying seeding rates at Indian Head (2015-16) and Melfort (2016).

Supporting Information

12. Acknowledgements:

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. The hybrid rye seed was provided in-kind by FP genetics and some of the in-crop herbicides used were provided in-kind by Bayer CropScience. The technical, administrative and professional support of Christiane Catellier, Danny Petty, Dan Walker, Karter Kattler, Carly Miller and Andrea De Roo is greatly appreciated.

13. Appendices

Figure A-1. Hazlet (OP) fall rye seeded at 50 seeds m^{-2} at Indian Head (July 29).

Figure A-2. Brasetto (HYB) fall rye seeded at 50 seeds m^{-2} at Indian Head (July 29).

Figure A-3. Hazlet (OP) fall rye seeded at 350 seeds m^{-2} at Indian Head (July 29).

Figure A-4. Brasetto (HYB) fall rye seeded at 350 seeds m^{-2} at Indian Head (July 29).

Table A-1. Treatment means for variety (hybrid vs. open pollinated) and seeding rate effects on fall rye plant densities (fall) at Indian Head and Melfort in 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Seeding Rate	All Varieties		Hazlet (OP)		Brasetto (HYB)	
	IH-16	ME-16	IH-16	ME-16	IH-16	ME-16
	---------- fall plants/m^2 ----------					
All Seed Rates	–	–	178 a	119 a	145 b	105 b
S.E.M.	–	–	3.1	5.2	3.1	5.2
50 seeds/m^2	54 f	57 c	69 h	63 ef	38 i	50 f
110 seeds/m^2	101 e	88 b	108 g	86 de	95 g	90 de
170 seeds/m^2	143 d	98 b	153 ef	106 cd	134 f	89 de
230 seeds/m^2	178 c	135 a	188 cd	139 ab	167 de	130 bc
290 seeds/m^2	235 b	146 a	268 a	166 a	202 c	126 bc
350 seeds/m^2	257 a	149 a	282 a	154 ab	233 b	144 ab
S.E.M	5.4	8.3	7.6	11.4	7.6	11.4
Orthogonal Contrasts	---------- Pr > *F* ----------					
NR – lin	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
NR – quad	0.201	0.075	0.794	0.162	0.043	0.248

Abstract

14. Abstract/Summary:

Field trials were established in the fall of 2015 near Indian Head and Melfort to demonstrate yield potential and seeding rate response of open-pollinated versus hybrid fall rye. Overall, the open-pollinated variety (Hazlet) was more susceptible to lodging and produced fewer tillers and heads m^{-2} than the hybrid (Brasetto). Lodging was reduced by utilizing optimal seeding rates (170-230 seeds m^{-2}) and was negligible in the hybrid regardless of seeding rate. Head density increased linearly with the OP rye and quadratically with the hybrid, presumably due to more tillers relative to the OP variety. While Brasetto yielded 18-26% higher than Hazlet depending on location, yields were optimized at similar seeding rates both varieties; however, at Indian Head, hybrid rye yields declined slightly at the most aggressive seeding rates while the OP rye yields did not. At Indian Head, percent ergot was lower overall with the OP rye but seeding rates of at least 170 seeds m^{-2} helped to minimize percent ergot for both varieties. This demonstration is continuing at Indian Head in 2016-17.